

Why Does
NASA Need
to Change?



This is
Local –
for NASA!



THE NASA VISION

To improve life here,

To extend life to there,

To find life beyond.

THE NASA MISSION

To understand and protect our home planet,

To explore the universe and search for life,

To inspire the next generation of explorers

... as only NASA can.



WHAT DOES SUSTAINABILITY
HAVE TO DO WITH NASA?

PLANET, PERFORMANCE, PEOPLE

1. PLANET – It is about our agency's mission and vision.
2. PERFORMANCE - It is how we service the public.
3. PEOPLE – It is who we serve today and tomorrow.

HUMAN SPACEFLIGHT: MOON AND MARS

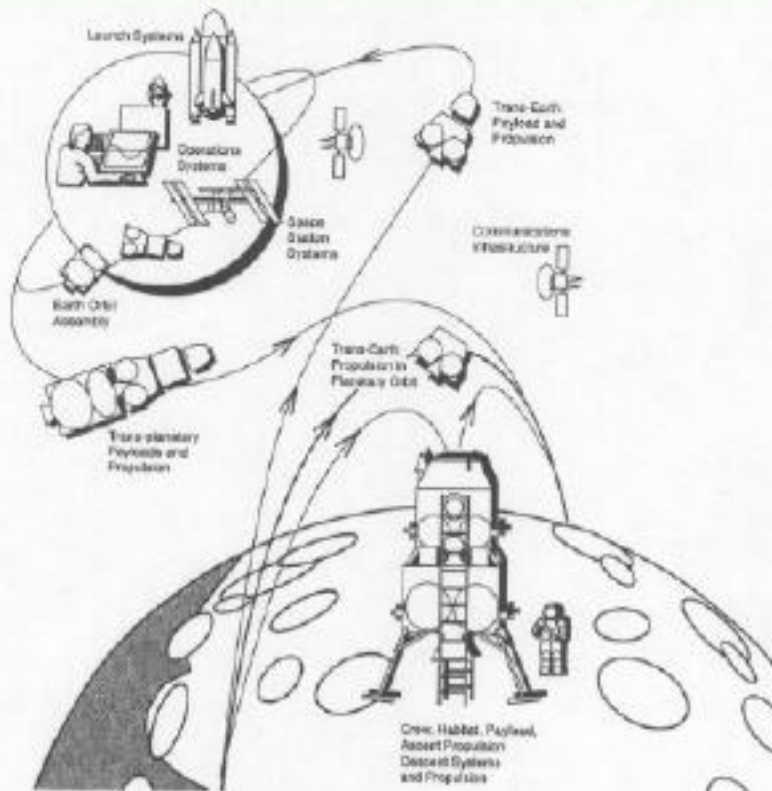


Fig. 1-6.

Example Mission Concept and Architecture for a Lunar Mission. Diagrams such as this one are very useful in communicating the overall mission concept. We will provide details of this concept throughout the book.

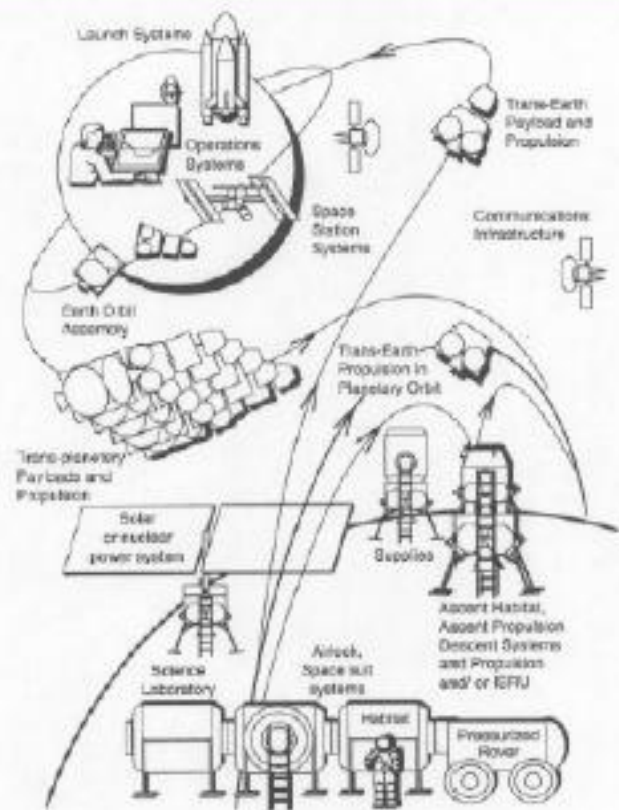


Fig. 1-6.

Mission Concept and Architecture for a Mars Mission. Chapter 31 details this concept.

SOME PERSPECTIVES OF THREE CIVILIAN AGENCIES

“SCIENCE, SECURITY & ECONOMY”

Earth, Moon, Mars & Beyond

The President's Vision for U.S. Space Exploration

There is a need for NASA to use a “Lego approach” in space exploration systems and off-world habitats for humans.

Failure #1
“SCIENCE & ECONOMY”
IN A REMOTE PLACE:
Pribilof Islands, AK

National Oceanic & Atmospheric
Administration



<http://response.restoration.noaa.gov/pribilof/>



<http://response.restoration.noaa.gov/pribilof/>



<http://response.restoration.noaa.gov/pribilof/>



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Failure #2
“SCIENCE & SECURITY”
IN A REMOTE PLACE:
Antarctica

“From heroic exploration (race for planting the flag)
To sustained scientific research”

National Science Foundation
U.S. Antarctic Program



http://www.antarctica.ac.uk/About_BAS/Cambridge/Divisions/EID/Environment/cleanup01.jpg



contamination to the surrounding environment.



The first waste bin prototype was tested at Thala Valley over the summer of 1999/2000.

www.cleanupantarctica.com/re_pages/strateg.html



www.cep.aq/default.asp?casid=6896



<http://www.anta.canterbury.ac.nz/>

Is This Failure #3?
**“SCIENCE, SECURITY &
ECONOMY”**
IN A REMOTE PLACE:
Earth, Moon, Mars & Beyond

National Aeronautics & Space
Administration

Look out

★ TRENDS, CULTURE, DISCOVERIES, IDEAS, PEOPLE

Science

Astronauts waiting for shuttle to pick up trash at messy station

There's no space in the space station.

So, a few weeks ago, the two astronauts who live there tossed out some useless junk, letting it float away in space.

The throwing-away — during a recent spacewalk — was done cautiously so that the discarded antenna covers and expired pump panel didn't become deadly boomerangs.

Such is life in space, post-Columbia.

With no garbage pickup by shuttles for nearly two years, the international space station is looking more and more like a cluttered attic.

A barrage of hurricanes and their devastating blow to NASA's launch site have delayed the next shuttle flight, by Discovery.

So the stuff will keep piling up

and up.

"It's at the point where we have to figure out a way to handle it. You can't just wish it away," said astronaut Kenneth Bowersox.

"It's essential that when that first shuttle comes up, before they do anything, they start to clear out

"We're in a constrained situation right now. But it's still a safe situation."

SUZAN VOSS
MANAGER OF NASA'S CARGO
INTEGRATION OFFICE, ON HOW
CLUTTER AFFECTS ASTRONAUTS

the items that we need to deliver back to Earth on the shuttle," astronaut Michael Foale said.

During Foale's six-month station stay, which ended in April, the overcrowding slowed him down and began to affect his work.

"We're in a constrained situation right now," observed Suzan Voss, manager of NASA's cargo integration office. "But it's still a

WASTE OF SPACE: Astronaut Mike Fincke tries to work around the gathering garbage.



Storage Space

safe situation."

Columbia's catastrophic plunge from the sky on Feb. 1, 2003, grounded the shuttle fleet

and halted all space station construction.

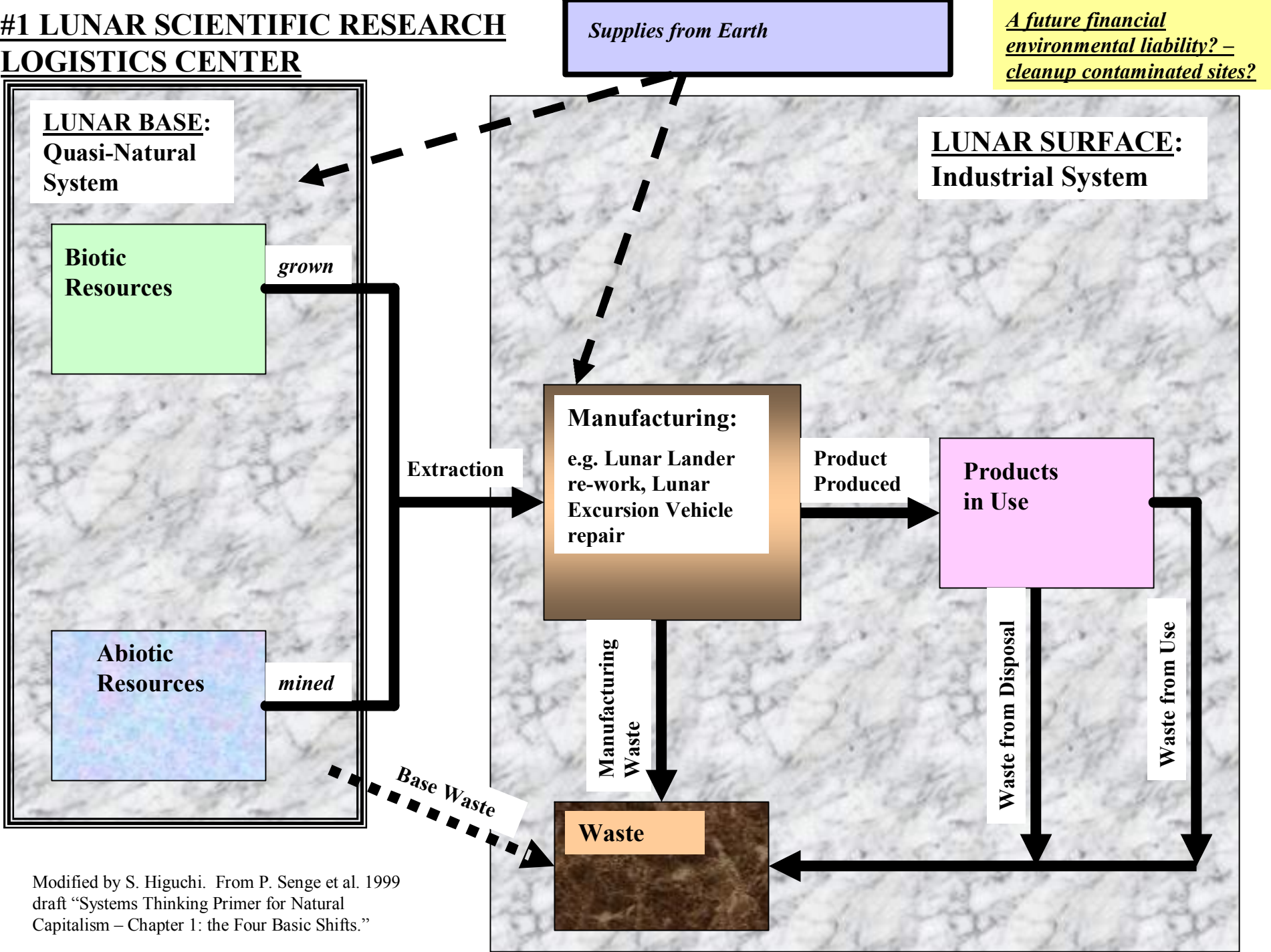
The Russian Space Agency has been sending manned capsules

and supply ships to the station. The cargo carriers have provided backup stores of precious oxygen that have come in handy during the repeated breakdowns of the station's main oxygen generator. Little can be returned to Earth in the capsules besides the astronauts themselves, and the cargo ships are cut loose and incinerated in the atmosphere. So only trash goes into the carriers before undocking — empty food containers, dirty clothes, aluminum toilet cartridges full of solid waste.

International accords frown on dumping things overboard; the objects could become dangerous pieces of space junk.

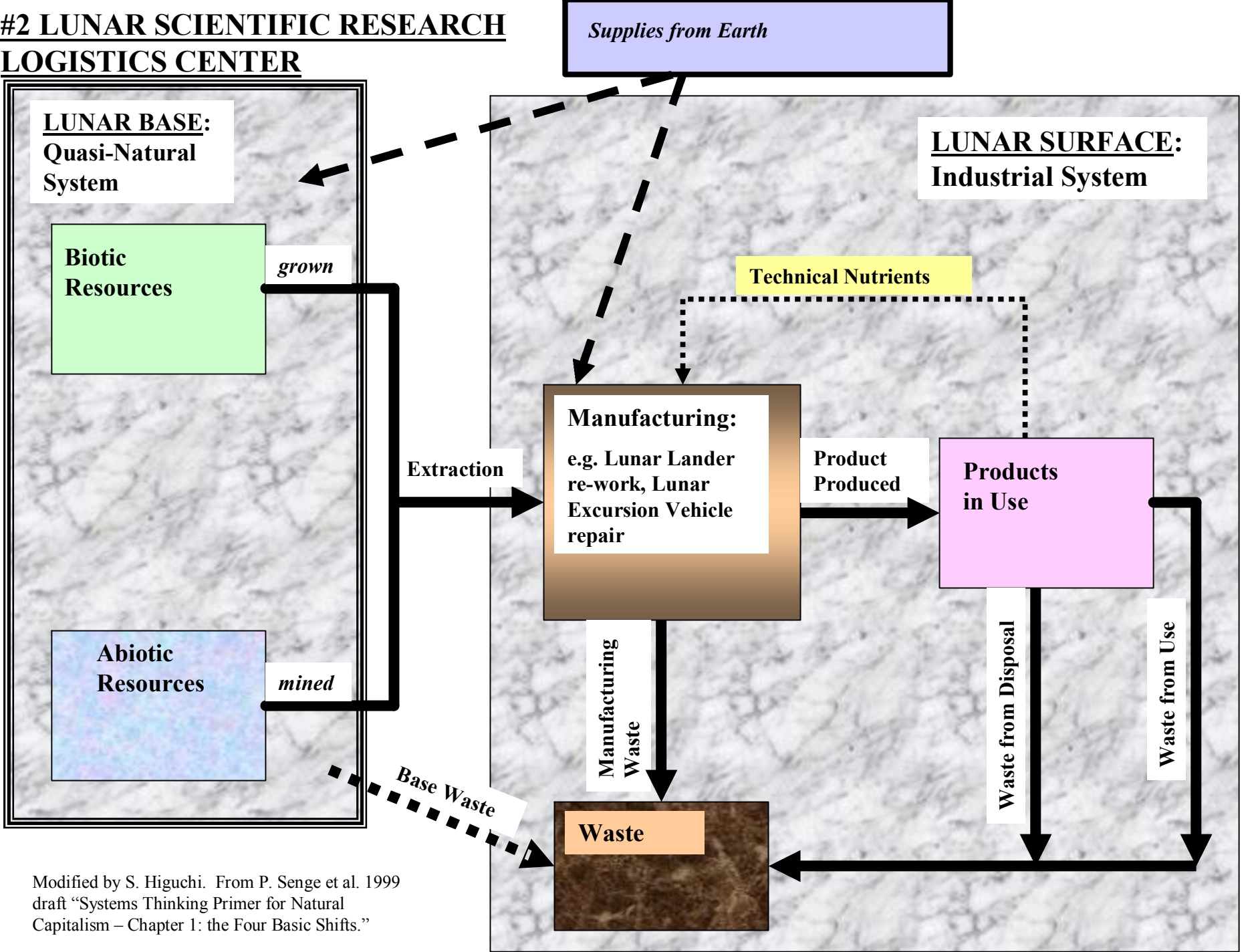
MARCIA DUNN (AP)

#1 LUNAR SCIENTIFIC RESEARCH LOGISTICS CENTER



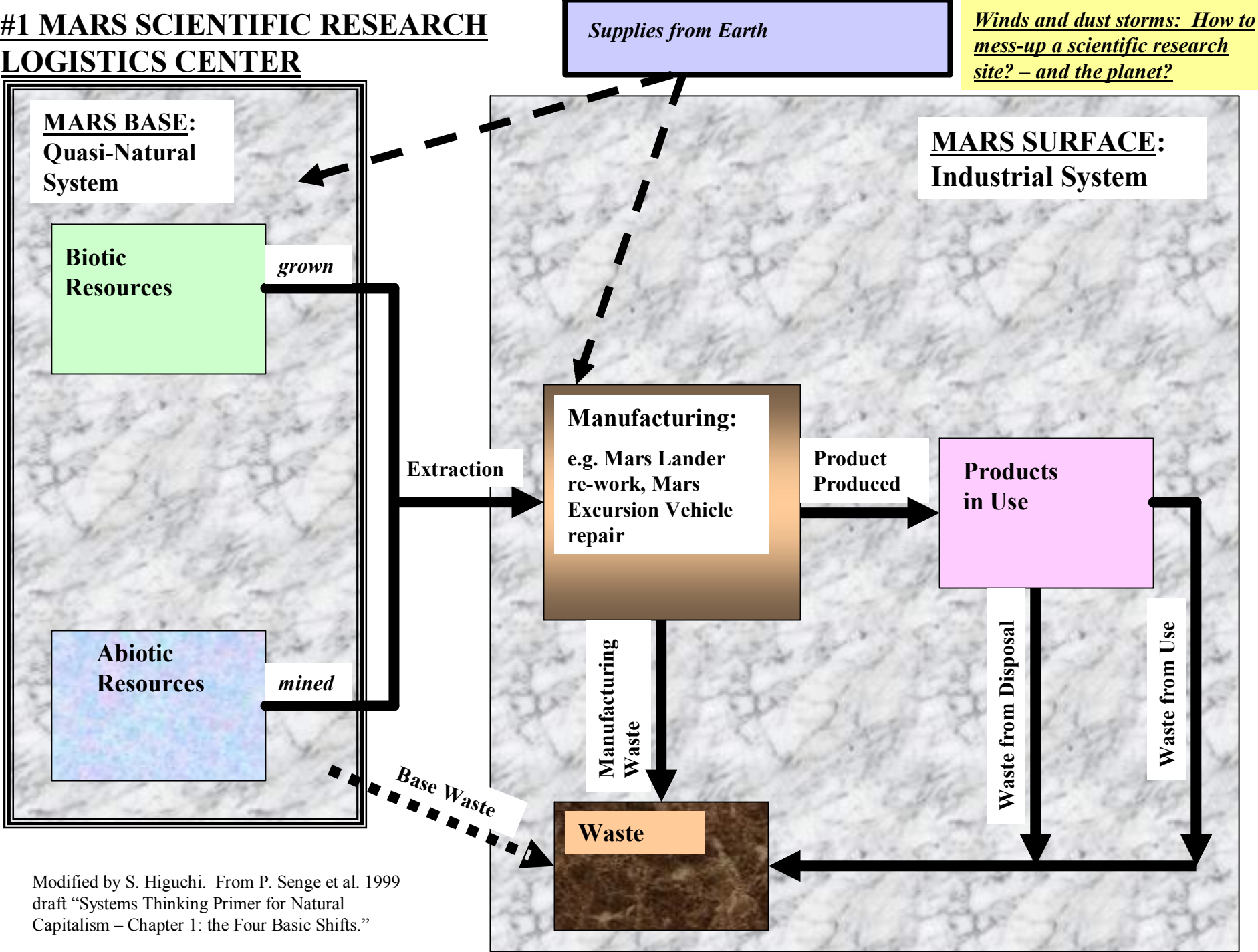
Modified by S. Higuchi. From P. Senge et al. 1999 draft "Systems Thinking Primer for Natural Capitalism – Chapter 1: the Four Basic Shifts."

#2 LUNAR SCIENTIFIC RESEARCH
LOGISTICS CENTER



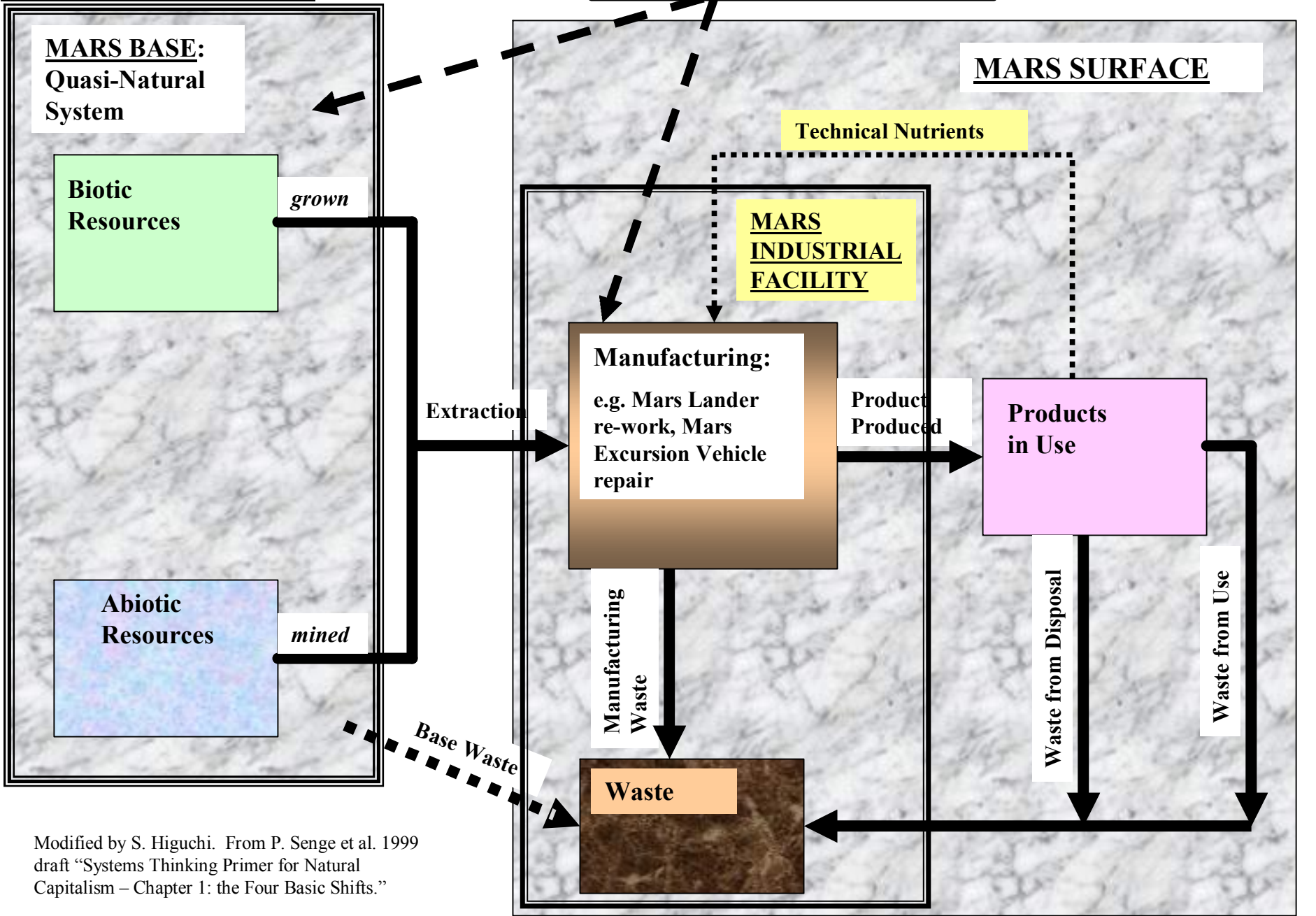
Modified by S. Higuchi. From P. Senge et al. 1999
draft "Systems Thinking Primer for Natural
Capitalism – Chapter 1: the Four Basic Shifts."

#1 MARS SCIENTIFIC RESEARCH
LOGISTICS CENTER



Modified by S. Higuchi. From P. Senge et al. 1999
draft "Systems Thinking Primer for Natural
Capitalism – Chapter 1: the Four Basic Shifts."

#2 MARS SCIENTIFIC RESEARCH
LOGISTICS CENTER



Modified by S. Higuchi. From P. Senge et al. 1999
draft "Systems Thinking Primer for Natural
Capitalism – Chapter 1: the Four Basic Shifts."

CREW ACCOMMODATIONS

GUIDING PRINCIPLE – R³

(From Teaching Science and Technologies, Inc. (not dated) Human Space Flight: Mission Analysis and Design)

- Reduce**
- Reuse
- Recycle

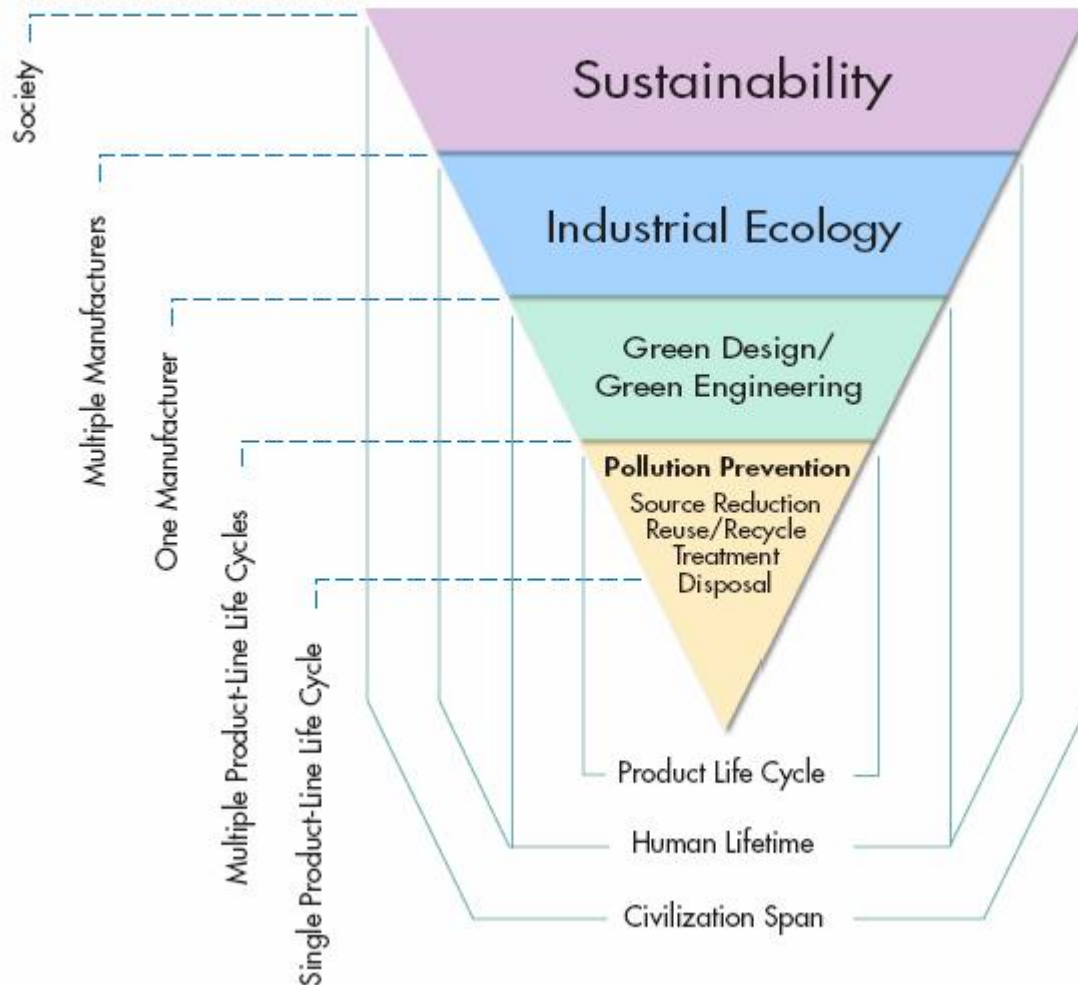
Accomplished through new technologies and scrubbing requirements.

‘5 R’ HIERARCHY OF SUSTAINABILITY

(From B. Dopplet 2003 Leading Change Toward Sustainability)

- Redesign*
- Replace*
- Reduce**
- Refine*
- Recirculate** (reuse and recycle)

Environmental and Organizational Scales of Environmental Impact Reduction Approaches



Modified from Coulter, Bras et al. 1995.

Sustainability: Optimizes the following three items simultaneously:

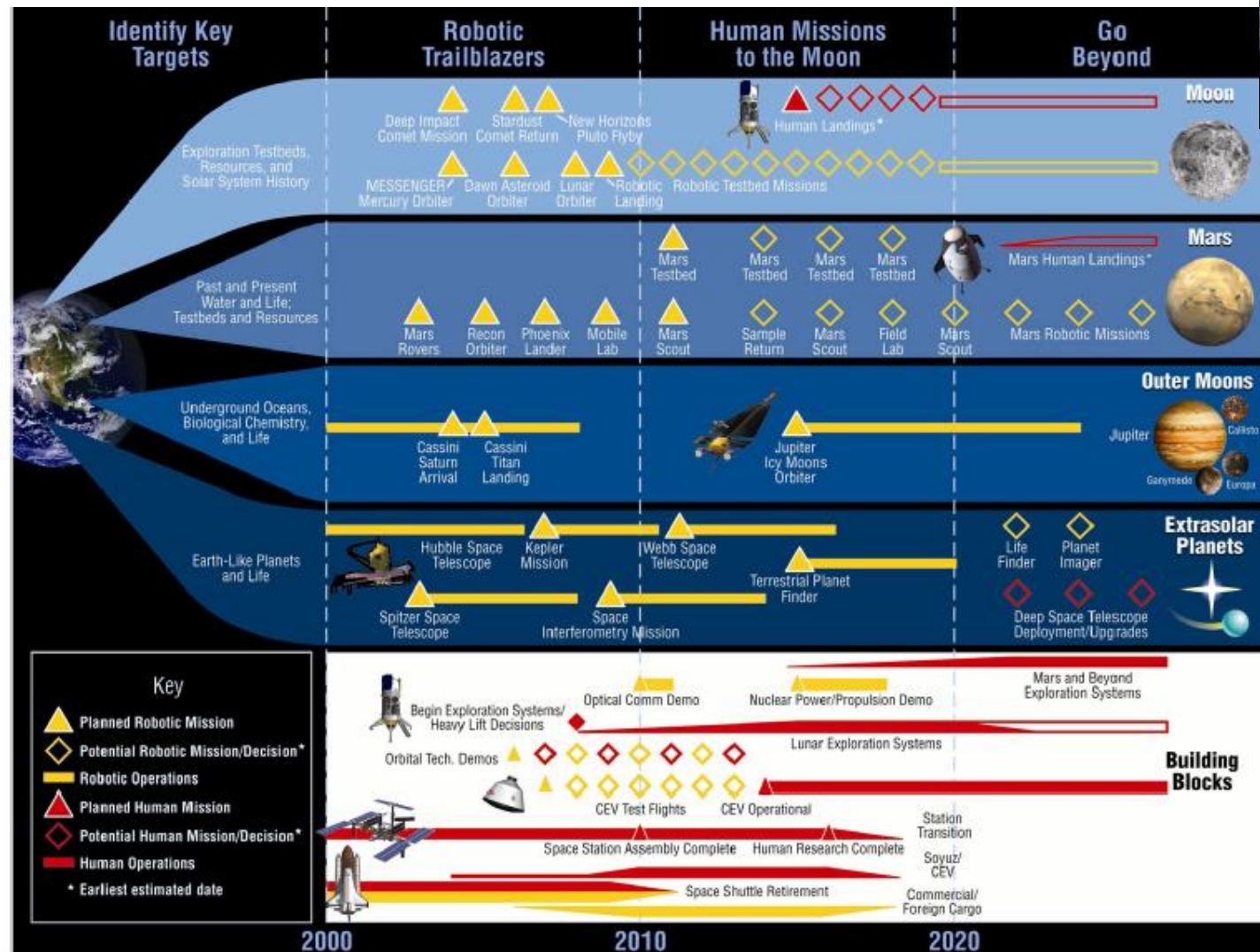
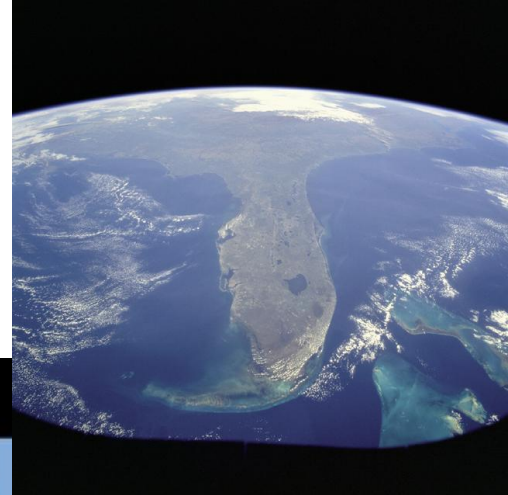
- 1) Renewable over non-renewable resources,
- 2) Ecosystem health, and
- 3) Human welfare.

Traditionally Pollution Prevention:

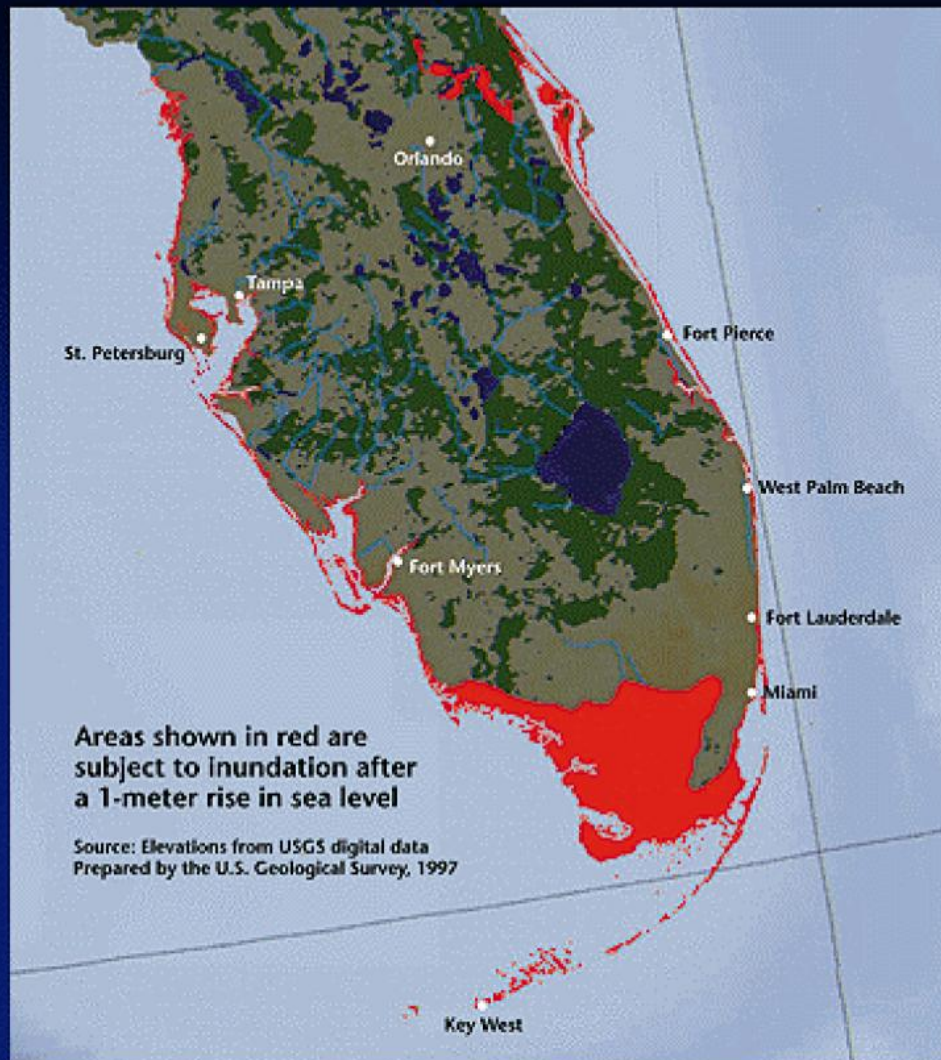
Minimizes one or more of the following:

- 1) Non-renewable resources, or
- 2) Environmental impact, or
- 3) Safety & health hazards.

So, what does Kennedy Space Center look like in 2020, 2030, 2050 – when we are ready to launch for Mars?



South Florida Shoreline Change after a 1-Meter Rise in Sea Level



From : John P. Holdren (Harvard University) 2003
“Risks from Global Climate Change: What do we
know? What should we know?” at Institutional
Investors’ Summit on Climate Risk United Nations.

“Hitting the Wall”

- Mature pollution prevention programs at Centers
- Compliance & P2 have not resolved all Center and most regional issues
==> Environmental issues still impact programs and facilities tremendously
- Primary mission – environmental considerations have not been integrated into mission, programs or projects

RISKS TO FUTURE NASA MISSIONS

<u>Societal Trend</u>	<u>Risks to NASA</u>	<u>Risk Mitigation</u>
Encroachment; proximity	Increase population density precludes some mission-critical activities	Negotiate with local/state communities for mutually agreeable buffer use
Increased regulation	Hazardous and toxic material may create future liabilities. Many currently available materials cannot be used.	Process re-engineering; material substitution; closed technical loops
Potable water scarcity and increasing demand	Unable to fulfill missions at facilities in NM, VA, CA, & FL	Rain water & gray water; recycling; conservation; xeriscaping
Increased demand for energy	Increased and unpredictable cost for energy. Decreased ability to perform mission	Conservation, efficiency improvements; renewable energy sources
Increased environmental concerns	Unanticipated regulation reduces options and increases cost for response	Move beyond regulation to proactive management of environmental risks
Resource/materials scarcity	Material cost will increase or materials will become unavailable	Invest in technology development & material substitution

STOP!